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A new species of *Bicoxidens* Attems, 1928 (Diplopoda, Spirostreptida, Spirostreptidae) from northern Zimbabwe

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Abstract

Bicoxidens aridis **sp. n.** is described from five male specimens collected from northern Zimbabwe. Besides being the smallest member of the genus, *B. aridis* has a hook-shaped distal telocoxite, a telopodite with a long postfemur and a proximal clockwise coil. The discovery of this species suggests that the geographical range of the genus may extend further north into Zambia.

Keywords

Millipede, gonopod, telocoxite, proplica, metaplica, telopodite, endemic, southern Africa

Introduction

According to Mwabvu et al. (2007), many southern African millipedes are unknown to science because several habitats have not been surveyed and because large quantities of material held in museums have not been studied. Our knowledge of the region's millipede diversity and distribution is therefore incomplete (Mwabvu et al. 2007).

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The genus *Bicoxidens* is endemic to southern Africa (Mwabvu 2000). It has been recorded in savanna woodland, riverine vegetation and forests south of the Zambezi River (Mwabvu et al. 2007). The distribution of *brincki* Schubart, 1966 extends southwards from Zimbabwe across the Limpopo River into the Kruger National Park, South Africa, and *flavicollis* Attems, 1928 extends eastwards from Zimbabwe to Maguge in western Mozambique (Mwabvu et al. 2007), but otherwise the genus seems to be restricted to Zimbabwe, particularly the central, eastern and southern regions (Fig. 3). Details of localities and synonymies of known species are provided in Mwabvu et al. (2007).

The genus is characterized by a telopodite which has neither antetorsal process nor torsotope, but which may have one or two lobes at the femur and terminally. Until now *Bicoxidens* had not been recorded from the Zambezi Valley, which led to the suggestion that the hot and arid conditions in the valley are less habitable and, therefore, restricted the spread of the genus northwards (see Mwabvu et al. 2007). However, a recent study of millipedes held in the Natural History Museum, uncovered a new species from the Zambezi Valley in northern Zimbabwe.

Material and methods

The material examined is housed in the Royal Museum of Central Africa, Tervuren, Belgium (MRAC) and the Natural History Museum, Bulawayo, Zimbabwe (NMZ).

Methods follow Mwabvu et al. (2007), and terminology follows Hoffman (2008). Specimens were studied using a Carl Zeiss Stereo microscope (Stemi DV4) and photographed using auto montage software (Leica Microscope MZ12s with 3 CCD Toshiba Camera). Adobe Photoshop CS (version 8) was used to manipulate the images and prepare the plate. In addition, images of the telopodite were produced using a JEOL JSM-6480LVscanning electron microscope. Material for electron microscopy was prepared following Barnett et al. (1991). ArcGis (Arcmap 9.1) was used to prepare the distribution map of species.

Description

***Bicoxidens aridis* Mwabvu, sp. n.**
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Type material. Holotype: ZIMBABWE: 1 ♂, Mbizi Pan [1628C4], 12. XII. 1983, Putterill G. (NMZ/D156).

Additional material examined. ZIMBABWE: 1 ♂, Nyamapanda [16° 90' S, 32° 80' E], XII.1998, Mwabvu T. (MRAC 20554); 2 ♂, Mushumbi Pools [1630B1], 22-25.XI.1997, (NMZ/D819); 1 ♂, Chimutsi (NMZ/D272).

Etymology. Specific name refers to the fact that the species occurs in a dry, low rainfall region.

Diagnosis. Distal telocoxite folded towards apical proplica, producing a hook shape and a median cavity (Figs 1a, 1b); lateral margins of proplica and metaplica setose; postfemur of telopodite as long as proplica, with a proximal clockwise coil distal to the femoral lobes, and without looping at the extremity (Fig. 2).

Description

Dimensions. Body length 73-88 mm; minimum and maximum body width 3-4 mm and 3.5-6 mm, respectively; antenna length 4-5 mm, extending up to the 3rd body ring; leg length 3-4 mm.

Number of body rings. 54-56.

Colour. Body light to dark brown; head light brown; antennae dark brown to black; posterior part of metazonite dark brown or black; prozonite cream; legs light brown.

Gnathochilarium. With long setae along distal margin of the stipes and lingual lamella; one small papilla behind and between the larger two.

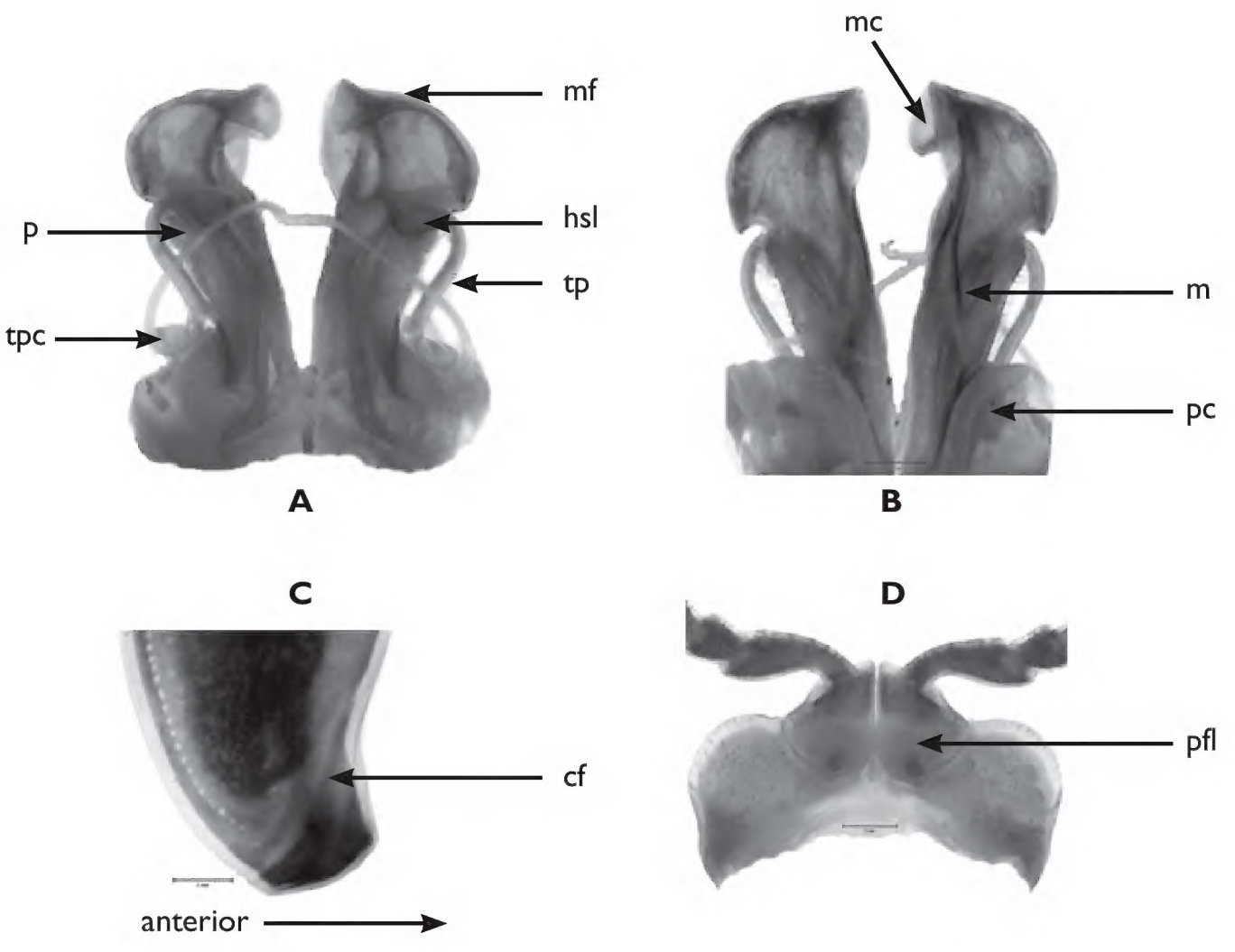

Figure 1. *Bicoxidens aridis* sp. n. **A,** oral view of gonopods; **B,** aboral view of gonopods; **C,** lateral view of collum; **D,** oral view of prefemoral lobe of first pair of male legs. Abbreviations: p, proplica; hsl, heart-shaped lobe; m, metaplica; mc, median cavity; tp, telopodite; tpc, telopodite coil; mf, metaplica fold; cf, collum fold; pfl, prefemoral lobe; pc, paracoxite.

First ozopore. On 6th body ring close to or on sigilla row.

Collum. Anterior corner rounded or square in shape, not produced into a lateral lobe, with 2-6 submarginal folds (Fig. 1c).

First pair of legs. Tarsal claws straight, but gently curved apically; prefemoral processes proximally parallel, but not touching medially, with laterally directed nipple-shaped apical lobes that are widely separated distally (Fig. 1d).

Sigilla. One row of large circles.

Midbody ring. Diameter of metazonite greater than prozonite, prozonte with up to 16 striae that are further apart posteriorly; limbus with straight edge.

Gonopod. (Figs 1a, 1b, 2) 4 mm long, with a triangular sternite; paracoxite rounded apically and basally fused to metaplica. Distally, metaplica of telocoxite hook shaped, laterally rounded and folded towards and overhanging apical region of proplica of telocoxite forming a median cavity (Figs 1a, 1b). Lateral margins of proplica and metaplica setose. Orally proplica with an apical heart-shaped lobe which conceals the telopodite at the knee (Fig. 1a).

Proximal half of telopodite broader than distal (postfemoral) half. Length of postfemoral region of telopodite equal to that of proplica. Telopodite bends laterally and produces a tight clockwise coil distal to the femoral lobes, above level of the paracoxite

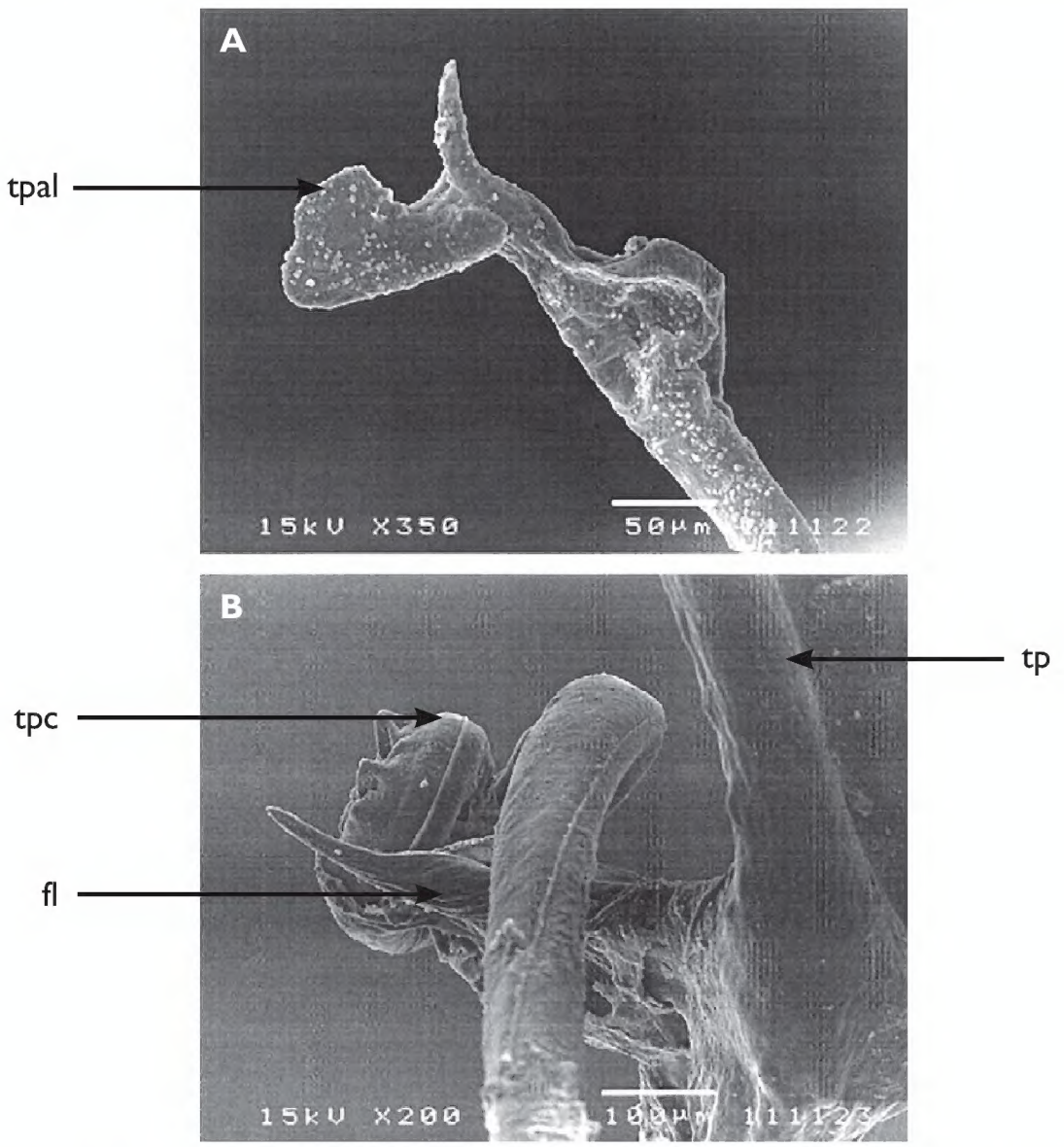

Figure 2. *B. aridis* sp. n. **A,** telopodite apex; **B,** telopodite coil. Abbreviations: tp, telopodite; fl, femoral lobe, tpc, telopodite coil; tpal, telopodite apical lobe.

(Figs 1a, 2b). Postfemur of telopodite extends distally towards the telocoxal apex and crosses the post knee part proximal to the coil and femoral lobes (Fig. 1a). Telopodite without apical looping, but with two unequal lobes at the extremity (Fig 2a).

Distribution. Appears to be widespread in the Zambezi Valley and northern Zimbabwe, a dry savanna region characterised by high temperatures and low, unreliable rainfall (Nyamapfene, 1991).

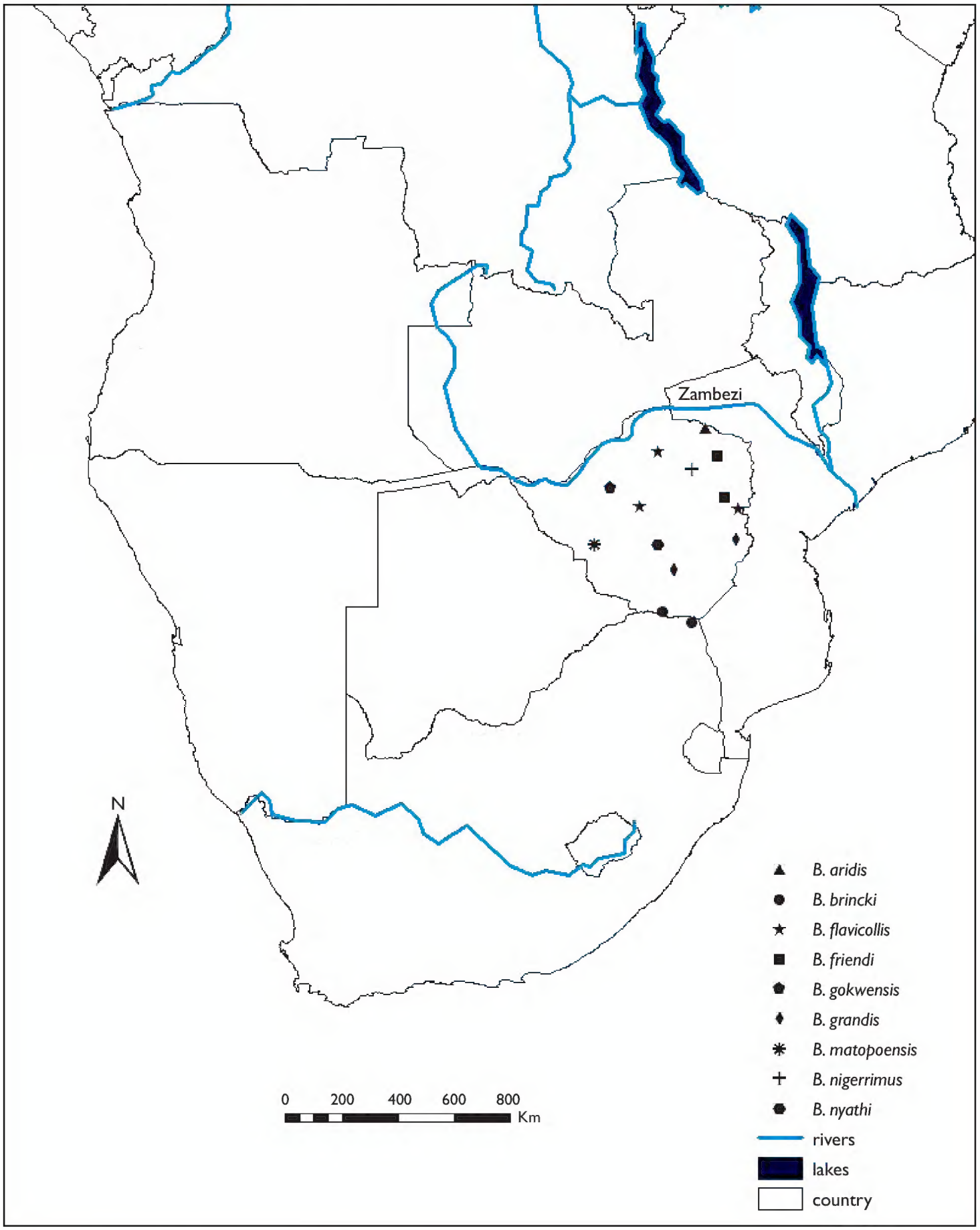

Figure 3. Distribution of *Bicoxidens* species

Comparisons

In terms of body width, *B. aridis* is the smallest among the known species in the genus. Other major differences relate to the structure and shape of the apical gonopod, and the clockwise coil of the telopodite at the femur.

Although the apical folding of the metaplica is more pronounced and produces a median cavity in *aridis*, folding of this structure is not unique to *aridis*; varying degrees of folding of the distal telocoxites was reported by Mwabvu et al. (2007) in *brincki*, *friendi* Mwabvu, 2000, *gokwensis* Mwabvu, 2007, *matopoensis* Mwabvu, 2007 and *nyathi* Mwabvu, 2007. However, the characteristic median cavity and telopodite coil are present in *aridis* only.

Unlike congeners, the distal telocoxite of *aridis* lacks lateral processes such as those found in *friendi*, *grandis* Lawrence, 1965, *nyathi* and *nigerrimus* Attems, 1928 or median processes similar to those found in *brincki*, *flavicollis*, *gokwensis*, *grandis*, *matopoensis* and *nyathi*.

Distally the proplica has a heart-shaped lateral lobe which covers the telopodite at the knee (Fig. 1a); which appears to prevent the telopodite from slipping out of the gonoschisma. A similar function was suggested for the apical lobe of the proplica which is found in *flavicollis* and *grandis* (see Mwabvu et al. 2007).

Unlike other species, the aboral surface of the metaplica of *aridis* does not have a lobe or projection at the level of the apical proplica. Additionally, the lateral margins of the metaplica and proplica are setose, while in other species only the apical region of the proplica is setose.

The post knee region of the telopodite of *aridis* is approximately twice as long as the proplica, in addition, the post knee telopodite is not L-shaped nor deflected medially at the level of the paracoxites or sternite (Figs 1a, 1b) as is the case in congeners (see Mwabvu et al. 2007). The telopodite typically produces a single clockwise coil just after the femoral lobes and lacks terminal bending or looping, making the shape of the telopodite unique to *aridis*.

An additional couplet would have to be added to the key to *Bicoxidens* species in Mwabvu et al. (2007) in order to accommodate *aridis*. This becomes the first couplet because the shape of the distal region of the telocoxite and the structure of the telopodite distinguish *aridis* from congeners:

1 Apical metaplica hook-shaped and with a median cavity (Figs. 1a, 1b), without produced lateral or median processes; post knee telopodite not L-shaped (Fig. 1a), with a clockwise coil after the femoral lobes and without looping at the extremity (Fig. 2) ..... ***Bicoxidens aridis* sp. n.**

– Apical metaplica not hook-shaped and without a median cavity; with produced lateral or median processes; post knee telopodite L-shaped, without a clockwise coil after the femoral lobes and with looping at the extremity..... .....**2** (all other *Bicoxidens* species, see key in Mwabvu et al. (2007))

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References

Attems C (1928) The Myriapoda of South Africa. Annals of the South African Museum 26: 1-431.

Barnett M, Telford SR, Villiers CJ (1991) Gonopod morphology of the millipede *Orthoporus pyrocephalus* (Diplopoda: Spirostreptidae) – a possible mechanism of sperm displacement. Electron Microscopy Society of Southern Africa 21: 179-180.

Hoffman RL (2008) Two new genera of spirostreptid millipeds from central Africa, with revised terminology for male gonopod structures (Diplopoda: Spirostreptida). Tropical Zoology 21(2): 167-186.

Lawrence RF (1965) New Spirostreptidae and Harpagophoridae (Diplopoda) from southern Africa. Memorias do Instituto de Investigacao Cientifica de Mocambmbique. Serie A 7: 38-39.

Mwabvu T (2000) Two new species of *Bicoxidens* Attems, 1928, from Zimbabwe (Diplopoda: Spirostreptida: Spirostreptidae). African Zoology 35 (1): 115-119.

Mwabvu T, Hamer ML, Slotow RH (2007) A taxonomic review of the southern African millipede genus, *Bicoxidens* Attems, 1928 (Diplopoda: Spirostreptida: Spirostreptidae), with the description of three new species and a tentative phylogeny. Zootaxa 1452: 1-23.

Nyamapfene K (1991) Soils of Zimbabwe. Nehanda Publishers, Harare, Zimbabwe.

Schubart O (1966) Diplopoda III: Pselaphognatha, Opisthospermophora, Colobognatha. In: Hanstrom B, Brinck P, Rudebeck G (eds) South Africa Animal Life 12, 86-89 & 118-120.